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REMEDY FOR THE EMBARRASSMENTS OF PENNSYLVANIA.

"The times are hard, and a lack of confidence, and bankruptcy prevail in an unusual degree."!!

The embarrassments of Pennsylvania have brought out one of her patriotic sons to devise the best means to extricate her, and which he has addressed formally by pamphlet to Governor Porter, proposing an amphibious or mixed order of transportation by railway and canal between Philadelphia and Pittsburg. The following is an abstract of his *requisitions* for carrying out this plan, which to be feasible, however, *only requires* that these requisitions be as easy to comply with as it is to swallow Dr. Brandreth's pills. Like the latter, to our mind, it savors no little of quackery, and as we have never heard of its being ever entertained at head-quarters, we infer it has been there so regarded. The author is evidently of the old or canal school, of whom it may be now asked, as of the Bourbons, "that while they forget nothing, neither do they learn anything." Specimen as follows:

1. *It only requires* to enlarge the locks of the Pennsylvania canals to 120 tons, to widen the bottom and to add another pair of gates,—all at a cost of $5,000 per lock, to effect a reduction of the toll and freight from 2 down to 1 cent per ton per mile, with a fair profit to the boat owner.

2. *It only requires* $3,000 per mile to lay a light railway on the banks of the canal, already graded for it, except for about a quarter

of a mile at each of the locks where the rise would be 40 to 50 feet per mile, between Columbia and Pittsburg, 269 miles.

3. *It only requires* the vigorous completion of the above plans at a trifling expense of only $1,677,000, and in the short time of only one year, to defeat the schemes now carrying on at great expense by New York, Baltimore and Boston, to take from Pennsylvania the western trade; and thus would her credit be at once raised and her debt wiped off, and the world convinced that she is really the keystone of the arch.

4. *It only requires* to make the boats on the fish plan in sections or links, overlaying each other like scales, and to be put together with all the ease of slipping the cover on a snuff-box, and these sections to follow the increase of trade so long as there is plenty of water and business.

5. *It only requires* this cheap kind of railway to answer all desirable and profitable purposes for an age to come, in place of the present fashionable high priced ones, by placing them on the tow path or berm bank of the canal, nine-tenths of the expense or grading of a railway is saved; and this union of the two improvements would attract business by allowing the trader to see the boats as they pass on the canal with his treasure and living, and how much would his desire to travel be incited and his delight enhanced, by the long vista of canal before him covered with deeply laden barges constantly wending their way to his favorite city or the far west. Two ton locomotives would here afford all the accommodation that is now afforded on the expensive roads suited to those of 12 tons, and there is, therefore, no reason why Pennsylvania should not occupy at once her vantage ground by making this her GREAT WESTERN RAILWAY connected with and appurtinent to her canals, to be got ready in a single year on the cheap but appropriate plan of not spending ten dollars when only one is enough.

6. *It only requires* to increase the power *sufficiently* at the inclined planes on the Portage road, to give them the facility of passing millions of tons per annum.

7. *It only requires* to contract the channel of the Ohio river to about 100 feet in width, by means of wing and channel walls to make it navigable and safe at all times.

8. *It only requires* the enlargement and doubling of the locks above proposed, to give the canals a capacity of six millions of tons, and of nine millions of tons by tripling them, and by deepening them one foot, one-third more would be added to their capacity, sufficient it is presumed for the present generation,—the next may

substitute the balance lock, and then their capacity may be increased fifty fold.

9. *It only requires* to cover the exposed parts with paved and sloped walls, and where they leak to lay the toe of the stones in a bed of hydraulic concrete, and to secure all the works with hydraulic lime mortar, to make our canals entirely free from breaches and risk,—reducing the expense to only $50 per mile, or rather exempting them entirely from repairs for hundreds of years.

10. *It only requires* to apply the waste water at the 174 locks on the canals between Columbia and Pittsburg, to iron furnaces, mills and other manufactories, to create a freight from the canal itself of 2,610,000 tons, the tolls on which, alone, independent of those on other produce, would be equal to paying off the whole cost of canal; but apart from this, the modification of our works as here proposed, would, no doubt, bring on them for the first year, 1,000,000 of tons and 60,000 passengers, the nett tolls on which would amount to $3,007,500 on this one single link between Philadelphia and Pittsburg; and the other divisions arranged after the same manner, would also become very profitable; and this source, over and above the business created by the canal itself, would also, in ten to fifteen years, liquidate the cost of these works.

11. *It only requires* the possession of canals, and railways follow nearly as a gratuity. nine-tenths of their cost being paid for already in the grading of the canal, and the cheap but appropriate ones here recommended to be laid on the tow paths, should be at once adopted, if it be possible to remove the *prejudices of the times in favor of the dear and heavy ones* made in the vain ambition to take the heavy freights from the canals.

12. *It only requires* to find purchasers for the water power of the 174 locks on the canals, equal to 10,440 horses, (and water power is cheaper and steadier than steam,) to make it yield a rent to the State of at least $288,000 per annum; with our water power thus employed, our work-shops would be at home and not in Europe.

It is not provided in this scheme at what speed the railway is to travel, but all the arrangements indicate that the tortoise and hare are to be harnessed together, and that the cars and boats are to keep company, if they can, at the canal rate, of about three miles per hour. The rival lines, however, from New York, Baltimore and Boston, which this scheme is designed to supercede, all having provided themselves with the means of going at a rate of at least ten miles with goods and twenty miles with passengers, would be the most likely to absorb all the business, leaving the Pennsylvania

scheme to find out that the cheapest is not always the most economical plan, but is most frequently the greatest pickpocket, and all *experience* goes to show that this is most particularly so with railways.

It would perhaps have been unnecessary to allude to this scheme, but that the light railway portion of it is attempted to be brought again into favor, and which we think should be opposed as very ill advised. We have never, however, believed in its obtaining any advocates, because it is founded on a basis at which the people will be sure to revolt,—that of making the cost of the provision for safety, despatch and accommodation, exactly commensurate with the amount of travel which may be reasonably anticipated; thus making different standards by which the lives and convenience of travellers are to be estimated according to their number, which must ever be a matter of the merest guess work.

What Pennsylvania really wants, is Mr. Schlatter's middle route of railway to connect Philadelphia with Cleveland, by which the western traveller could be put sure twelve hours sooner into New York city, passing through Philadelphia, than by any other route; but as desirable as this supremacy may be to her, we trust she will never attempt it, except by an improvement of the most permanent and distinct species.

To make the *shortest time* is now to win the race,—the canallers to the contrary notwithstanding.

We have received, through our friend, Joseph E. Bloomfield, "The proceedings of the Western railroad corporation, of 21st January, 1842," and the following extracts of an "Address to the people of Msasachusetts," by that indefatigable friend of railways, Mr P. P. F. Degrand, "was read and unanimously adopted."

Mr. Degrand, with great propriety, rebukes the Government of the United States for its parsimony and desire to take advantage of private enterprise, without an adequate compensation, compared with the benefits received. It is stated that the line of railways from Boston to Albany, has cost upwards of $9,000,000, built without any aid from the Post Office Department, but in view, no doubt, by the corporators, of receiving the modicum of $300 per mile per annum, allowed by the present law of Congress. a sum, if we are correctly informed, about half the rates paid by the British Government to their private railroad incorporations, on *main lines*, such as the Western railroad must be considered. This road is one of much importance to the General Government for our sea-board

defence. It will connect us at West Troy with the principal depot for arms, guns and the manufacture of gun carriages, in the United States. On the east, by the Western railroad, it will unite us with the United States' armory, at Springfield, Massachusetts, thus rendering the cities of Boston and New York impregnable to foreign invasion. The query is very properly made by Mr. D, "How unreasonable then, has it been for the Post Office Department to hold up to public obloquy the price asked by the Western railroad for the transportation of the mail, on the ground that *it was higher than the charge by the stage coaches.*"!!

We were struck with the delicate flattery administered to our legislature, and to the canal interest, to induce them to take off all restrictions on the line of railroads parallel to the Erie canal,—Mr. D. observes:

"The enlightened friends of the Erie canal, a work of infinite good, cannot allow themselves to sustain a restriction so clearly inconsistent with the spirit of the age.

"A simple suggestion to the legislature of New York, from the legislature of Massachusetts, will doubtless suffice to produce the desired effect."

Following this address, we find our legislature have been invited by the Western railroad company to meet the legislature of Massachusetts at Springfield, to give them this suggestion. We Van Winckles certainly require some hint of this kind to *enlighten* us. We consider the Western railroad has been built as much for the advantage of the city of New York as of Boston, and we will hold up both our hands in favor of the present legislature taking off all restrictions on the railways, parallel to the Erie canal, whereby the western trade may be turned into the lap of Boston.

It would appear that our rich capitalists and property holders require a spur of this kind, to take up and complete the *New York and Albany railroad*, the only work than can *immediately* head off our enterprising neighbors. We have too long depended on the natural advantages of the Hudson river. How important and profitable to us to have an *iron* avenue, a *second Hudson river*, to connect us with upwards of one thousand miles of railways that will be finished by July next, extending from Portland, in Maine to Buffalo, intersecting the Boston and Albany railroad, distant 117 miles from this island, in Chatham, Columbia county. We understand that subscriptions have been tendered to our citizens from the country to complete half this distance. Why then do we delay the work? The stock must be a profitable investment, inasmuch

as a great city, with near 400,000 souls is at the southern termination for travel and traffic with the whole of New England,—the Canadas,—with near 1,000,000 of souls in our own State, and the millions beyond it, will seek us *at all seasons*, if we afford them the same facilities now held out by Boston. With a railroad *direct* to Albany, we may consider the *Western railroad* built for the especial profit and convenience of the city of New York.

"WESTERN RAILROAD ADDRESS.

"*To the people of Massachusetts:*

"FELLOW CITIZENS: Thanks to the enlightened forecast of the legislature of Massachusetts, your ardent and patriotic desire of reaching by railroad, the mouth of the Erie canal, has been accomplished. We have now secured, for all time, to Massachusetts, as well as to New England, whose trade centers in our own State, the best line of communication to the great west, which the light of the age has given to mankind. Let us render thanks to a kind Providence, that we have been enabled to accomplish this great national purpose, in a very brief space of time, in the midst of unparalleled difficulties in the money market and through chains of mountains, which seemed to present insuperable obstacles.

"The line of railroad between Boston and Albany, with its numerous appended communications by steam, in all directions, all over New England, forms a web, which, without cost to the nation, defends almost every harbor in New England, and some even out of New England. Placing at every point, even to the frontiers of Canada,—the power of commanding, with great celerity, the concentration of a great force, this web warns foreign powers of the futility of any attempt to make a lodgement on our territory, and is not only our best defence in war, but also, and emphatically, our best negociator for the preservation of peace.

"FELLOW CITIZENS: Amidst the wreck of State credits, in all directions, the credit of Massachusetts has stood unshaken; and now the completion of the communication to Albany by the Western railroad furnishes the additional guarantee of the revenue of that road, to meet the interest and sinking fund of the $4,000,000 debt, contracted by the State in aid of this great work.

"We are, however, forewarned by the times, that it is highly important to adopt every measure in our power, which may have a natural tendency to decrease the total amount of our State stocks.

[Here follows plan of a sinking fund.]

"FELLOW CITIZENS: By means of the Western railroad, a great national work,—constructed without the slightest disbursement by

the Treasury of the United States,—a very powerful fleet can, in a few days, (of winter as well as summer) be equipped on Lake Erie, on Lake Ontario, on Lake Champlain,—with materials, munitions of war, workmen and seamen, brought from the Charlestown navy yard.

"FELLOW CITIZENS: The Western railroad, between Worcester and Albany, will, with a single track, cost, - - - - - - $6,700,000

Add to this, the cost of the Boston and Worcester railroad, - - - - - - 2,300,000

And we have an expenditure of, - - - $9,000,000

For the line of 200 miles of railroads, between Boston and Albany. These railroads form the only link, on which the land mail can be transported, in a way satisfactory to common sense, either between Boston and Albany and places right and left of the road,—or between Boston and New York, as far as Springfield,—or even between Albany and New York city, in the winter, as to some portion of the Western railroad. This line of railroads between Boston and Albany, has been constructed without any contribution from the Post Office Department. The cost of these 200 miles of railroads and of their repairs, is borne by their stockholders. How unreasonable then, has it been for the Post Office Department to hold up to public obloquy the price asked by these railroads for transporting the mail, on the ground that it was higher than the charge by coaches!

In the case of the coaches, transporting the mail on the common roads, the interest on the cost of these common roads, cost to the coaches, nothing, say, $00 00

The repairs of said common roads, cost to said coaches, 00 00

Total cost, to the coaches, for construction and repairs of the common roads, on which they carry the mail, $00 00

Now let us see how the case stands, as to the railroads:

The interest on the above $9,000,000, which is their cost, at 6 per cent. per annum, is, - - - $540,000

Repairs annually, - - - - - - 60,000

Interest and repairs, annually, - - - - $600,000

"Is it reasonable, then, to compare the charge by coaches, to the charge by the railroads, and to say nothing of this annual difference of $600,000?

"Suppose that these railroads should say to the Post Office Department, 'just do for us *gratis*, what is done *gratis* for the coaches,—and we will transport the mail, for nothing!'

The result would be an annual payment, by the Post Office Department, of, - - - -	$600,000
Whereas, the railroads are content to take, at present, what the law allows the Post Master General to pay, viz.— - - - - - -	60,000
Thus making every year, a saving to the United States, of, - - - - - -	$540,000

"Fellow Citizens: The nation spent several millions, in constructing the Cumberland road to insure the transportation of the mail, as well as to insure other national purposes, which are better performed by the railroad system. Is not the interest on the cost of the Cumberland road, or some portion of that interest chargeable, as a part of the cost of transporting the mail, by coaches, on the Cumberland road?

"Shall, then, the people of Massachusetts, who, as stockholders, own one-third of the Western railroad, and who have loaned $4,000,000 upon it, make no effort to impel the Post Office Department to give to it a suitable compensation, for the transportation of the mail,—a compensation having some sort of reference to its great cost and to the cost of its repairs? Or shall their voice be heard, in favor of a suitable remuneration, for all this capital and for the risk incurred in embarking this capital, in a scheme which many deemed, until now, very hazardous? Shall the press speak? Shall the legislatures of Massachusetts, of New York, and of the great west (to whose citizens the Western railroad, for all practical purposes belongs,) speak and request their Senators and Representatives in Congress, as well as the President of the United States and his cabinet, to cause justice to be done by the Post Office Department to a work so highly useful to the whole country, and in which the people of Massachusetts have so deep an interest in every point of view?

"Fellow Citizens: In interchanging resolves, at a very early period, and in the various steps of legislation which led to the building of the Erie canal, and more especially of the line of rail-

roads from Massachusetts Bay nearly to Lake Erie, the legislature and the people of both Massachusetts and New York States could not but have in view to secure for western New York, during the 4 winter months, as well as for the other 8 months of the year,—a commercial and a social existence,—to secure, for that great, populous, thriving, industrious and growing portion of the State of New York, access to the sea, throughout the year. The restriction, as to carrying freight, on a portion of the railroads parallel to the Erie canal, is clearly inconsistent with this beneficent original intent. The enlightened legislature of New York will doubtless perceive (the very moment its attention is called to the subject) that the time has now arrived, when the public interest, as well as even handed justice to western New York, requires that this restriction be taken off, even if it should be deemed proper to accompany this permission to take freight, by a moderate toll, charged to the railroads, on such freight, for the benefit of the canal fund. It surely cannot be the desire of an impartial legislature to confine to the neighborhood of the single city of Albany, the winter access to the markets of the whole world. To deny this access, is to decree four months of comparative idleness;—to decree the loss of the best time to sell, for a vast amount of agricultural products, and of the best time to buy, for a large amount of goods from New England and from abroad. It is to decree the loss of four months' interest on the enormous amount of the winter supplies, and of the sales of agricultural products, which will be made in the winter, if the law permit. Whatever might be said, in favor of the restrictive policy, while Albany had no winter-access to the ocean, disappears, now that the promethean heat of locomotive fire has given her life during the dead season. The winter is the time when fresh fish and fresh provisions can be transported freest from the danger of being spoilt. It is the time when the farmer is most at leisure and when he can, most conveniently, visit the seaboard with his produce and his family and select such returns as he may desire.

"The enlightened friends of the Erie canal,—a work of infinite good,—cannot allow themselves to sustain a restriction, so clearly inconsistent with the spirit of the age.

"A simple suggestion to the legislature of New York, from the legislature of Massachusetts, will doubtless suffice to produce the desired effect.

"Fellow Citizens: We cannot forbear adverting to the uniform kindness and enlightened spirit, with which the mayor, council and people of Albany, and indeed the governor, the legislature and the people of the State of New York have cherished every step of

our great enterprise. They have had a just conception of its immense advantages to both States and to the whole country. Indeed the Commander in Chief of the State of New York ordered a national salute of 26 guns to be fired, in commemoration of the opening of the Western railroad, as an event greatly contributing to the defence of the country and to cementing the Union. The recent personal exchange of the most cordial feeling, between a large body of the citizens of Massachusetts and a large body of the citizens of Albany, Hudson, Troy, western New York and other parts of that great State,—will be ever remembered with gratitude to that Supreme Being, who thus cemented bonds of friendship which must have a most salutary effect on the whole of our beloved country, and which we trust will endure till time shall be no more.

[For the American Railroad Journal and Mechanics' Magazine.]

CHAMPLAIN AND ST. LAWRENCE RAILROAD COMPANY.

"Extracts from the proceeding of the half-yearly meeting of the stockholders of the Champlain and St. Lawrance railroad company, held on Monday, the 17th instant, at the office of the company:

"William Connolly, Esq., was called to the chair, and Mr. W. D. Lindsay, acted as secretary.

"John E. Mills, Esq., as chairman of the committee of management, made the following report, which was received and adopted by the meeting:

"*Chairman's report to the stockholders.*

"GENTLEMEN: The statements which we now have the honor to submit to this meeting cannot but be highly satisfactory to the stockholders of the company; and notwithstanding the difficulties we had to encounter last season, arising from extreme low water and loss by incendiarism, we are enabled this day to declare a dividend, payable on 1st of February next, of eight per cent. upon the capital paid in, besides leaving a contingent fund of £2,104 for future operations. This result must fully prove the capabilities of the company, and confirm the value of our stock in the estimation of the public.

"We refer you to the commissioner's report for more general details, and will merely call your attention to that part of it which refers to the Laprairie ferry, and recommend our successors in office to give the improvements suggested upon this portion of our line of communication their serious attention, as of the utmost importance to the interests of the company.

"While the public prints are almost daily recording casualties on

other railroads, we are most happy to have it in our power still to congratulate the stockholders and the public upon having been so far favored by the absence of all accident involving the safety of passengers transported over our road.

"It also gives us much pleasure on this occasion to express our entire satisfaction at the manner in which the officers and servants of the company have discharged the duties of their respective stations.

"JOHN E. MILLS, *Chairman.*

"*General statement.*—

Gross receipts of 1841,		£14,000	0s 0d
Current expenses,		8,758	14 7
Nett gain 1841,		£5,241	5 5
Contingent fund on hand, January 18, 1841,	£2,177 8s 10d		
Out of which laid out for additions and improvements,	2,114 3 5		
		63	5 5
Total amount at disposal of the company,		£5,304	10 10
Out of which a dividend of 8 per cent. is declared upon the capital stock paid in—£40,000—is		3,200	0 0
Contingent fund carried to 1842,		£2,104	10s 10d
Number of passengers in 1841,		26,357	
Tons of goods and lumber,		12,614	

"W. D. LINDSAY, *Commissioner.*

"RAILROAD OFFICE, MONTREAL, *January* 17, 1841."

The above railway is 15 miles long, and the ferry traversed is 9 miles. The maintenance of the latter is very expensive, as the rapid to be overcome in ascending, is one of the severest, if not, indeed, the very worst, in the country.

The following abstract of current expenses has been furnished by Mr. Lindsay. The road has been in operation 6 years, but for the first 3 years the accounts were kept in a different manner.

HEADS OF EXPENDITURE.	1839.	1840.	1841.	Average.
Motive power,	£710 18s10d	£731 9s11d	£856 1s 7d	$3,064 69
Repairs of cars,	338 14 40	420 2 00	409 3 2	1,490 63
Maintenance of way, bridges and buildings,	894 10 9	550 18 5	940 9 9	3,221 29
Expenses of freight department,	508 7 7	570 2 3	747 4 7	2,434 29
Incidental expenses,	743 8 7	1,029 3 10	731 5 3	3,338 48
Expenses of wharf at St. John's,	— — —	138 16 5	106 1 3	489 72
Interest account,	713 14 11	461 18 2	422 11 10	— —
Salaries of officers,	1,187 00 00	1,535 13 11	1,564 10 00	5,716 26
Expenses of steamboat,	2,399 18 5	2,652 9 3	2,981 7 2	— —
	£7,496 13s 5d	£8,120 14s 2d	£8,758 14s 7d	$19,755 36

The total expenses are, therefore, $1,317 per mile, and the repairs of railway, bridges and buildings, are $214 75 per mile, per season of 7 months.

Adding the sum, due to the interest, to the paid up, capital $160,000 (£40,000) and we have $188,173 as the entire capital invested. This includes a steamboat and several barges for towing, deducting the value of which, the cost of the road, fixtures etc., would be nearly $11,000 per mile, including wharves costing $15,000.

The total cost of right of way, graduation and superstructure for 15 miles including 2 engines, 6 first class passenger cars, 50 freight cars, depots, shops, platforms, woodyards and water stations is $10,000 per mile.

For the first 5 years, the road earned 10 per cent. per annum; during which time the wooden rails were all renewed and the spikes for the plate-rail replaced by new and better ones, made by hand, of refined iron. These were not only far superior to, but were actually cheaper than, Burden's spikes, which had been previously used.

Freight and passengers are carried in the *same* train, at the rate of 15 miles per hour, and the trains are seldom *full*. It is obvious that the success of the road is due to the economy of its construction, for, with a substantial track, the dividends would have been reduced one-third. On the other hand the expenses are necesarily great, as all the freight is handled three times, and a large force must be kept at the wharves in readiness for the business which is exceedingly irregular. The management of this road and ferry is about as expensive as, and much more difficult than, the management of a continuous railway of 50 miles, or perhaps 100 miles, doing merely a passenger business. Considering that the freight yields a large portion of the income, the management of this little railway will compare favorably with that of any road in this country.

W. R. C.

New York, *March* 16, 1842.

[For the American Railroad Journal and Mechanics' Magazine.]

RAILROADS VS. CANALS.

A remarkable illustration of the capability of railroads to compete successfully with canals in the transportation of *freight* appears in the history of the Boston and Lowell railroad. This road runs in a directly parallel line with the Middlesex canal, 25¾ miles; it was constructed at a time when experience had given little practical knowledge to contractors or engineers, and its cost when completed, with a double track, amounted to the enormous sum of $71,000 per mile. Notwithstanding these great disadvantages, it appears from the annual report made under oath to the legislature of Massachusetts, that the company has divided annually for the last five years an average of 7⅗ per cent., reserving at the same time out of the nett income, a fund sufficient to keep the road in complete repair, and to renew the track when required. It also appears that the amount of income derived from freight has been rapidly increasing during the last five years, having amounted in 1837, to $63,137, and in 1841, to $121,588. The income from passengers has also steadily increased, but not in the same ratio, having been in 1837, $117,643, and in 1841, $145,953. The principal part of the income from freight on this road is derived from the transportation of cotton in the raw and manufactured state; and what will be most surprising to a New Yorker, is the fact, that since this road has been in operation, the use of the Middlesex canal, *running in a directly parallel line, and terminating at the same points*, has been almost wholly discontinued.

As a further illustration of the profits to be derived from the transportation of freight on railways, it may be stated that the *Lowell and Nashua* railroad, 14 miles in length,—a continuation of the Boston and Lowell railroad,—took, in

1837, from passengers, $36,647, from freight, $18,405,
1841, " " 75,732, " " 56,761.

The freighting business having more than trebled in three years, while that from passengers did not quite double. The dividends on the Nashua and Lowell railroad in 1839, was 6½ per cent., 1840, 7½ per cent., 1841, 8 per cent.

As a stronger proof of trade and travel deserting a canal in a populous and manufacturing district, it may be stated, that since the completion of the Boston and Providence, and the Boston and Worcester railroad, the Blackstone canal has fallen into disuse, inasmuch as valuable manufactures, and their raw material in cotton seeks the Boston and Worcester railroad and the Boston market,

in preference to the Providence market. In this case, the introduction of railways has changed the market and mode of transportation.

On a former occasion, I noticed the decline of the Farmington and Northampton canal, parallel to the New Haven and Hartford railroad and Connecticut river, since the improvement of the latter.

The great contest for superiority, between railways and canals, judiciously located, is about to be submitted to a fair test this season, in the transmission of a bulky article, coal, from Pottsville to the city of Philadelphia, and without any reference to passengers, the only object for which many contend that a railway should be constructed.

It is much to be regretted that our legislators heretofore have been so wedded to canals, that they would not examine into the comparative merits of railways. Is it because our State is so largely interested in canals, that our public officers consider it their duty to protect canals by a tax on private enterprise, even if they tax the people to carry out works, that may share the fate of the Middlesex, Blackstone and Farmington canals?

J. E. B.

PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS.

Experiments on the strength of iron girders. *By* THOMAS CUBITT, *Assoc. Inst. C. E.*

This communication gives in a tabular form the results of experiments upon upwards of 60 pairs of cast iron girders, varying in length between 7 feet 6 inches and 27 feet, with corresponding depths, and of all the forms usually adopted for beams for buildings. They were proved in pairs by a hydraulic press placed between them, the ends being retained by wrought iron ties. The deflexion was noted at each increase of pressure, and in many instances the beams were factured.

Sketches of the girders, and of the apparatus used for proving them, accompanied the paper; from them five drawings have been made at the institution, to facilitate a reference to the information contained in the communication.

Description of an improved level and stand. *By* G. TOWNSEND.

This improvement being intended to procure a firmer basis and greater facility of adjustment than by the ordinary level, the author has adopted the principle of the triangular plate, with three levelling screws. In the ordinary instrument, with two pairs of screws, it has been found that the antagonist screws, besides being apt to wear unequally, and to indent the lower plate, are sometimes bent, and thus cause an unequal action upon the upper plate. To

obviate these defects, the screws in the tripod level are made to work into inverted cones, which are fixed in the three grooved arms of the stand head; the weight is more equally distributed, and the telescope more speedily brought to a level.

The telescope is fixed to the levelling plate by an upright limb, and to this is added a small longitudinal cross level, as in Gravatt's instrument. In the improved stand, each of the legs is attached to two arms of the lower tripod plate, by which means a firmer basis is obtained. The usual locking plate, to secure the levelling screws, is also attached to this instrument, and kept in place by a spring catch; there is also a metal ring fixed on the upright limb, above the arms, and which falls into three spring catches in the table plate, by which any derangement from accidental violence or in removal from one station to another, is effectually prevented.

A small circular spirit level is fixed in the stand in order to adjust it before the instrument be placed on it, by which means the labor of adjustment is considerably abridged.

Memoir of the Montrose suspension bridge. By J. M. Rendel, *M. Inst. C. E.*

Previous to the year 1792, the passage of the river Esk at Montrose was effected by common ferry boats; at that period an act of parliament was obtained for the construction of a wooden bridge, with numerous arches, or rather openings formed by beams, supported upon piles, with stone abutments at either end; the action of the tide undermining the piles, and the usual progres of decay causing great expense for repairs, it was decided in the year 1825, to erect a suspension bridge, the iron work of which was contracted for by Captain Samuel Brown, R. N., for the sum of £9,430, and the masonry of the towers for £9,080. The total cost being £18,510, exclusive of the land arches and approaches; those of the old bridge being preserved for the new one.

The dimensions of the new bridge were:—

	Feet.
Distance from centre to centre of the towers,	432
Deflection of the chain or versed sine of the catenary,	42
Length of the suspended roadway,	412
Width of ditto,	26
Height of ditto above low water,	21
Ditto of the towers above ditto,	68
Base of the towers at the level of the roadway,	40 by 20
Archways through the towers,	16 wide, 24 high

The towers were built of red sandstone ashlar, raised on a base of the same material, carried upon piles.

Construction.—There were two main chains on each side, arranged above each other in parallel curves, 12 inches apart. Each chain was composed of 4 bars of iron, 5 inches wide by 1 inch thick, and 10 feet long, united by short plates and strong wrought iron pins. The roadway was suspended to these chains by perpendicular rods, 1¼ inch in diameter, attached at intervals of 5 feet, alternately, to the upper and lower lines of main chains, at the joints,

which were arranged so that those of the upper chain should be over the long bars of the lower one; at the lower end of each suspending rod was a stirrup, which received and carried the cast iron bearers for supporting the roadway.

Upon these bearers was laid and rivetted longitudinally a flooring of fir planks, 3 inches thick, and well caulked; upon this a sheathing of fir, 1¼ inches thick, was placed transversly, and spiked to the lower planks; over all was spread a coating of about 1 inch thick of fine gravel and sand, cemented with coal tar.

The suspending rods were without joints. The main chains rested upon detached cast iron saddles, built into the masonry of the towers, and passing down at either extremity, were secured behind cast iron plates in masses of masonry, 10 feet under ground.

The construction was commenced in September, 1828, and was finished in December, 1829, a period of only sixteen months.

Accident to the bridge.—On the 19th of March, 1830, about 700 persons assembled on the bridge to witness a boat race, when one of the main chains gave way, and caused considerable loss of life. The injury was speedily repaired, but a careful survey of the structure was ordered, and it was discovered that the intermediate or long links of the chains bore so unequally upon the saddles as to be bent and partially fractured. Mr. Telford, who was consulted on the subject, proposed the addition of two other main chains placed above the original ones, and having the same curve, so as to increase the sectional area 40 inches—thus, giving 6 chains of 20 inches area each, instead of 4 chains, as originally constructed.

Mr. Telford's decease occurring at that period, the author was instructed to report upon the state of the bridge, and advise such alterations as he judged to be necessary.

After a minute personal inspection he concurred in Mr. Telford's idea of the necessity of increasing the strength of the bridge, but instead of augmenting the number of the chains, he advised the addition of two bars in width to each of those existing, by which means the required strength might be gained. He was led to this by an opinion that, in all cases, it is desirable to have as few chains as possible.

It appeared that there had been but little precision in the workmanship of the chains; for on releasing them they immediately became twisted; thus showing that all the links had not a true bearing. On taking them apart, many of the traversing pins were found to be bent, and some of them were cut into, evidently, by the friction of the links. This was to be rectified, and new saddles of a different principle and stronger form were recommended: also, that those parts of the chains which rested in the saddles should be entirely composed of short plates. Additions to the masses of masonry holding the chains were likewise deemed advisable.

Between the years 1835 and 1838, all the principal works, with many minor improvements, were executed.

In the author's report on the state of the bridge, he noticed what he deemed defects in the construction of the roadway, but as there was no positive symptom of failure, it was allowed to remain. He

conceived, that in the anxiety to obtain a light roadway, mathematicians and even practical engineers had overlooked the fact, that when lightness induced flexibility, and consequently motion, the force of momentum was brought into action, and its amount defied calculation.

On the 11th of October, 1838, the roadway of the bridge was destroyed by a hurricane, the effect of which upon this structure is the subject of a paper by Colonel Pasley, published in part 3, volume 3, of the transactions of the Institution C. E. To that account the author refers for the principal details, only adding, that on inspecting the bridge, he found the chains, the saddles, and the fastenings or moorings, quite sound; the principal portion of the roadway had been completely carried away, and the remainder much injured. He then gives some account of the undulatory motion observed during the storm. This motion was greatest at about midway between the towers and the centre of the roadway; but the waves of the platform did not coincide with those of the chains, either in magnitude or in order; no oscillatory motion was perceived either in the roadway or in the chains, although particular attention was directed to them.

It appears that the centre of the platform fell in a mass. This the author attibutes to the failure of the suspension rods, which, having no joints, were twisted off close to the floor by the undulatory motion. A similar occurrence at the Menal bridge induced Mr. Provis to adopt the joints in the suspension rods, which the author had previously introduced at the Montrose bridge.

The author had long been convinced of the importance of giving to the roadways of suspension bridges the greatest possible amount of stiffness, in such a manner as to destribute the load or the effect of any violent action over a considerable extent.

The platforms of large bridges, in exposed situations, are acted upon in so many different ways by the wind, that he had an objection to the use of stays or braces to counteract movements which ought rather to be resisted by the form of the structure.

Holding such opinions, he determined to adopt a framing which, although connectedly rigid in every direction, should nevertheless be simple, composed of few parts, capable of being easily renewed; should distribute its weight uniformly over the chains; not be subject to change from variation of temperature, and not augment the usual weight of suspended platforms.

The details of the alterations, and general repair of the bridge, are then given; a few may be mentioned.

An entirely new set of stronger suspending rods was introduced; they were $1\frac{1}{8}$ of an inch in diameter down to the flexible joint at the level of the platform; below that point the diameter was increased to $1\frac{3}{4}$ of an inch, and a strong thread was cut on to the lower end, so as to adjust them to the requisite lengths.

In the place of the cast iron bearers, cross beams were substituted, composed of two Memel planks, 13 inches deep, $3\frac{1}{2}$ inches thick, bolted together, and trussed with a round bar $1\frac{1}{4}$ inch diameter; every sixth beam had a deep trussed frame on the under side, so as

to give great stiffness. Above and beneath the cross beams, on each side of the carriage way, were bolted two sets of longitudinal timbers, four in each set; they were further united by cast iron boxes, at intervals of 10 feet; and the ends were secured to beams of English oak, built into the masonry of the towers. A curb of Memel timber, 11 inches by 6 inches, was attached to the ends of the cross bearers, and extended the whole length of the platform.

The planking of the footways was composed of narrow battens, 2 inches thick, laid transversely from the inner longitudinal beam to the outer curb piece, with an inclination or drip of 1½ inch in 5 feet.

The carriage way was formed of four thicknesses of Memel plank; the two lower layers, each 2 inches thick, were placed diagonally with the transverse beams, crossing each other so as to form a reticulated floor, abutted against the longitudinal beams; they were firmly spiked to the beams, and to each other, at all the intersections, and upon them was laid and spiked a longitudinal layer of Memel planking, 2 inches thick. Over the whole was fixed, transversely, a layer of slit battens, 1½ inch thick. Each layer was close jointed and caulked, and the upper one was laid in a mixture of pitch and tar. A composition of fine gravel and sand, cemented with boiled gas tar, was laid over the whole, to the thickness of 1 inch, forming the road track.

To add to the stiffness afforded by this construction, the author caused to be passed through the spaces between the pairs of longitudinal beams, a series of diagonal truss pieces of Memel timber, 6 inches square, with their ends stepped into the cast iron boxes, which, at every 10 feet grasp the beams. On the other ends of these diagonal truss pieces, cast iron boxes were fixed, which received the straining pieces, placed 3 feet 6 inches above, and the same depth below, the roadway: an iron screw bolt, 1½ inch diameter, at every 10 feet, and a contrivance of wedges in the cast iron boxes, enabled any degree of tension to be given to the framing.

The roadway was thus stiffened by two of the strongest kinds of framing, in parallel lines, dividing the carriage way from the foot paths; it was deemed preferable to disconnect them from the suspending rods, and, by bringing them nearer together, to avoid a twisting or unequal strain. The whole formed a compact mass of braced wood work, the diagonal plank giving the horizontal stiffness, and the two trussed frames insuring the vertical rigidity.

The weight of the new roadway was:—

	Tons.	Cwt.
Wood work,	130	19
Cast and wrought iron about ditto,	36	6
Wrought iron in the suspending rods,	20	14
Ditto in the fencing,	8	18
Gravel concrete,	30	0
Total,	226	17

Or 47.5 lb. per square foot, superficial, for the entire roadway.

The weight of the original roadway was:—

	Tons.	Cwt.
Wood work,	69	0
Cast iron about ditto,	92	0
Wrought iron in the suspending rod,	12	9
Gravel concrete,	30	0
Total,	203	9

Or 23 tons less than the new roadway.

Cost.—The platform described is 412 feet long, and 27 feet wide; it cost £4,026 or about 7*s.* 3*d.* per superficial foot.

The works were completed in the summer of 1840; the bridge has borne without injury the gales of the last winter; and the stiffness of the platforms has given confidence in its strength to all who have examined it.

Five elaborate drawings of the bridge, giving all the details of its construction on a large scale, accompanied this communication; they were presented by Mr. Page on his election as an associate of the institution.

Mr. Seaward agreed with Mr. Rendel in the advantage of reducing the number of suspension chains, and thus rendering the whole construction as simple as possible. The trussed framing, which appeared to be the main feature of this bridge, was particularly deserving of commendation, as it imparted a degree of stiffness to the platform which had not hitherto been attained in other cases, although it was demonstrated to be the best method of preventing the undulation which was so prejudicial to the suspension bridges.

Mr. Rendel had, on a previous occasion, explained his view of the action of wind upon the platforms of suspension bridges, and of the necessity of a certain degree of stiffness in the construction; this he conceived would always be better attained by having a simple well trussed framing to prevent undulation, than by the application of braces or stays to check either undulation or oscillation—the latter being in his opinion only the result of the former.

He would now only insist more forcibly upon those points. The roadway should be so stiff as to prevent as much as possible all tendency to motion, because it added to the natural decay of every part of the structures; for instance, he found on taking down the chain of the Montrose bridge, after seven or eight years' wear, that the pins of the links were cut some depth into; demonstrating how great had been the amount of motion among the links. In constructing suspension chains, after this experience, he should be inclined to abandon the circular form for the pins, and forge them of a long oval shape in their transverse section; making the apertures in the links by drilling two holes, and cutting out the metal between them with a machine; this form of pin would allow sufficient play for the necessary curve of the chain, while the pin itself would be stronger,—would weaken the link less than the large circular hole, and would be less expensive to manufacture. He disap-

proved of all the complicated contrivances for allowing expansion of the main chains; he had found that plain saddles of proper form were quite sufficient to permit the expansion of the back chains, which was all that required attention.

Mr. Palmer mentioned, on the authority of Mr. Chapman, the destruction of a suspension bridge in America, caused by the sudden passing of a drove of cattle when frightened. This was peculiar, as it always had been considered that an irregular motion was innocuous, but that when any regular impulses were communicated, there was danger of fracture of the bars.

Mr. Vignoles eulogized this excellent communication for the practical conclusions which it contained. Mr. Rendel had materially assisted in affording facility of communication by the introduction of the floating bridges, in communication with railways, and it was not difficult to foresee that, by carrying out the system of adapting well trussed framings to the platforms of suspension bridges, sufficient rigidity would be obtained for locomotive engines and carriages on railways, to traverse rivers or ravines by means of these bridges, instead of by costly viaducts or heavy embankments.

Mr. Rendel saw no difficulty in giving any required amount of rigidity to the platforms; it was only necessary to increase the strength of the framing, to enable the roadway to bear with perfect safety the passage of an engine and a train of carriages.

The President directed the attention of the members to what he considered the most valuable part of this interesting communication—the detection of the errors in the original construction of the bridge. This was the most useful class of papers which members could present to the institution, and they were particularly valuable when they were illustrated by such complete drawings as those now communicated by Mr. Page on his election. He hoped this example would be extensively followed. He mentioned that an attempt had been made to carry a railway across the Tees by a suspension bridge, but it had been abandoned.

Mr. Rendel understood that the weight of the trains had so stretched the chains, or rather forced the moorings of the back chains of the bridge over the Tees, that the platform sunk in the centre so as to prevent the passage of the carriages; piles had therefore been driven beneath each bearer of the roadway, and the chains now remained merely to show that it had formerly been a suspension bridge.

"*Supplementary account of the use of auxiliary steam power, on board the 'Earl of Hardwicke' and the 'Vernon' Indiaman.*" *By* SAMUEL SEAWARD, *M. Inst. C. E.*

The advantage of the employment of auxiliary steam power, on board large sailing ships, had been shown by the author in a former paper (page 63); it was now further exemplified by the result of the recent voyages of the "Earl of Hardwicke" and the "Vernon."

Earl of Hardwicke.—This vessel, of 1,000 tons burden, with one engine of 30 horse power, effected the voyage from Portsmouth to Calcutta in 110 days, a much longer time than usual; but still

with an advantage of 29 days over the "Scotia," a fine vessel of 800 tons, which sailed one week before the "Hardwicke," and arrived 22 days after her. During the voyage, the "Hardwicke" used her engine 364 hours, and was propelled by it 946 knots; an average of nearly 3 knots per hour; while in a calm, with the ship steady, she made 5 knots per hour. The total consumption of fuel was 90 tons.

The "*Vernon,*" which sailed one month after the "Hardwicke," made her passage to Calcutta in 97 days; passed the "Scotia," and arrived 7 days before her, gaining 42 days upon her during the voyage. The "Vernon's" consumption of fuel was also 90 tons, but the copy of her log not being arrived, the number of hours during which steam was used, could not be ascertained.

The "*India*" steam ship, of 800 tons burden, with engines of 300 horse power, had not arrived at Calcutta, although she had been out 109 days, so that the "Vernon," with only auxiliary steam power, had already gained 12 days upon her.

The comparison between the advantages of these two vessels, in point of expense, is then fully entered into, and shows a saving of £3,733 in favor of the "Vernon," on a single voyage, while she gained at least 12 days upon the "India," in point of time.

This communication is accompanied by a copy of the log of the "Earl of Hardwicke," and by letters from the captains of that ship and the "Vernon," speaking in the highest terms of the assistance of the steam power in certain parts of the voyage.

"*Description of an improved levelling staff, and a modification of the common level.*" *By* THOMAS STEVENSON.

In enumerating the advantages of this improvement, the author passes in review the different levelling instruments in general use. He describes the self-reading staff as very useful, but ill adapted to the extreme accuracy generally necessary in the operation of levelling. He considers the running level to be equally inadequate, from the difficulty of attaining a precise coincidence in the cross wires and the vane line.

On the authority of Mr. Simms, in his Treatise on Mathematical Instruments, he states that these evils are in some measure remedied by Mr. Gravatts's rod, but he still considers that instrument to be imperfect. He therefore caused a rod to be constructed by Mr. Adie, of Edinburgh, the vane of which is adjusted by tangent screws. The range of this staff is 12·7 feet, and the graduation so perfect as to be read by verniers to the $\frac{1}{1000}$th of a foot. On the right of the lower portion of the rod there is a screw, which, on being tightened, clamps the vane, and on the opposite side is the tangent screw for adjusting it. Supposing in practice that the level line strikes the lower half of the rod, the vane and screw are then easily moved by the hand to within $\frac{1}{4}$ inch of the point, and then, by means of the tangent screw, perfect correctness can be attained.

After having sent his communication to the institution, the author learnt from the secretary, that adjusting screws had already been

used in two other levelling staves by Captain Lloyd and by Mr. Bunt. He was not, however, aware of this circumstance, and he considers that these instruments being adapted only for scientific purposes, are hardly suitable for the ordinary use of the engineer.

Improved level.—The author also introduced a ball and socket joint at the junction of the legs of the common level, retaining at the same time the parallel screw plates, and adding beneath a small sluggish spherical level. By these means the surveyor is enabled to station the instrument, regardless either of the inequalities of the ground, or of the inclination of the telescope to the horrizon.

When in use, the clamp of the ball and socket is released, and the head of the level moved until the bubble shall be in the middle of the circle; the socket screw is then clamped, and the telescope brought to the absolute level by means of the parallel screws. It becomes thus unnecessary to move the legs of the instrument when once fixed.—*Civil Engineer and Architect's Journal.*

CAST IRON LIGHT-HOUSE, IN PROGRESS AT MORANT POINT, JAMAICA.

By ALEXANDER GORDON, *Engineer to the Commissioners.*

In writing a description of a cast iron light-house tower, just completed for the island of Jamaica, an opportunity is afforded for a few words on the advantages offered by this peculiar mode of construction. Mariners have frequently been deprived of the security afforded by light-houses on dangerous coasts, from the great costliness of such structures, as well as from the danger or difficulty attending their erection, in consequence of local peculiarities arising either from tidal restrictions, or from the difficulty of obtaining foundations of sufficient solidity to support the heavy mass of masonry of the tower. It is a fact, of common occurrence, that years are required to erect a light-house of very moderate dimensions where the rate of working is limited, both by the nature of the tides, and by the peculiarity of the season; and the authorities who preside over these matters, are frequently deterred from entertaining the application, for such facilities to navigation, from the cost and trouble attending their execution.

Mr. Alexander Gordon, the engineer to the commissioners appointed to carry the plan into effect, is the designer of this building, and who recommended the adoption of cast iron, in consequence of the suggestions some years ago of Captain Sir Samuel Browne, and the subsequent erection of a small light tower on Gravesend pier, by Mr. Clarke.

The advantages which iron, when not in contact with sea water, possesses over stone or other materials, is, that upon a given base, a much larger internal capacity for dwellings and stories can be obtained with equal stability. The nature of the material, admitting of the plates being cast in large surfaces, there are fewer joints, and consequently greater solidity. A system of bonding the plates may also be adopted, which will insure the perfect combination of every part, so as to form one entire mass, and by the facility which such a plan offers for uniting the parts, the best form for strength

and stability can be obtained. The time required for the construction of such a building in iron being less than that required for the preparation of one of stone, would in many instances influence its adoption, and from the comparatively small bulk and weight of the component parts of the structure, much greater facilities are afforded for transporting and erecting it at its destination. It is a fact, worthy of remark, that in less than three months from the date of the contract, the light-house in question was cast and erected on the contractor's premises, and it is the intention of Mr. Gordon, the engineer, to have the light exhibited in Jamaica, on January 1st, 1842, being six months from the date of its commencement. This is a degree of expedition commensurate with the extraordinary despatch of the present day, when all operations, however great and difficult, seem to advance with a celerity which a few years back would have been deemed chimerical.

The expenses of the construction, the transmission to its destination, and its final erection, will not exceed one third the cost of a stone building of equal dimensions and capabilities, and in localities where the materials are not naturally produced, but have to be transported from a distance in a fit state of immediate erection, the expense would considerably exceed this ratio. Another prominent feature in the construction of iron light-houses, etc., is the security from electric influence, the material itself being one of the best conductors of the electric fluid, and if proper means be taken to transfer the electric fluid from the base of the tower to the sea, by means of copper conductors, no danger need be apprehended from its effects.

The light-house in question, is the first of its kind that has been practically carried out, and from its having to withstand the destructive hurricanes. which, as well as the frequent earthquakes that occur in the West Indies, it will afford a good example for future practice. The form has been selected as well for strength as for symmetry; and the arrangement of the lantern and light apparatus reflects the greatest credit on the manufacturer, Mr. Deville.

The tower is to be founded on a coral rock, a little above the level of the sea, the face of which rock is about 10 feet beneath the surface of the sand, and which will be excavated to receive the base of the tower, resting on and cased with granite, to prevent the natural filtration of the sea water from acting upon the iron. The course of granite upon which the base of the tower rests, is grooved to receive the flange of the lower plates, from which the lightning conductors are continued to the sea. The diameter of the tower shaft is 18 feet 6 inches at its base, diminishing to 11 feet under the cap; it is formed of 9 tiers of plates, each 10 feet in height, varying from 1 to ¾ inch thickness. The circumference is formed of 11 plates at the base and 9 at the top; they are cast with a flange all round the inner edges, and when put together these flanges form the joints which are fastened together with nut and screw bolts, and caulked with iron cement. The cap consists of 10 radiating plates which form the floor of the light room, and

secured to the tower upon 20 pierced brackets, being finished by a light iron railing. The lower portion, namely 27 feet, is filled up with masonry and concrete, weighing about 300 tons, and so connected with the rock itself that it forms a solid core of resistance; the remaining portion of the building is divided into rooms which are to be appropriated as store rooms and berths for the attendants in the light-house.

The light room consists of cast iron plates 5 feet high, on which are fixed the metal sash bars for receiving the plate glass, these terminating in a point are covered with a copper roof, from which rises a short lightning rod, treble gilt at the point, to attract the electric current.

The light is of the revolving kind, consisting of 15 Argand lamps and reflectors, 5 in each side, of an equilateral triangle, and so placed as to constitute a continuous light, but with periodical flashes.

In order to preserve as low a temperature as the nature of the circumstances and climate will permit, the iron shell is to be lined with a non-conducting material, such as slate or wood, leaving an annular interstice, through which a constant ventilation will be effected, and by which the excessive heat will be carried off, or which it will doubtless be assisted by the evaporation of the sea spray which may be accidently cast upon it, as it will be placed within 60 yards of the ordinary water level.

In order to preserve the two lower tiers from oxidation, they have been coated with coal tar, and Mr. Gordon intends to set them in the granite with a bituminous cement. The only bracing which has been thought requisite, is a few cross ties at each horizontal joint, over which the iron tongued wood floors are laid.

The several rooms are provided with five apertures fitted with oak sashes glazed with plate glass; the approach to the doorway, which is about 10 feet above the level of the sand, will be by means of stone steps, ladder irons are also provided in the event of the stone steps being carried away by a hurricane.

Over the entrance is a large tablet of iron, supported by two small ones, and on them, in bas relief, are the following inscriptions:—

"Erected A. D. 1842,
"Under the act 3 Victoria, cap. 66.
"COMMISSIONERS.

"Vice-Admiral Sir Charles Adam, K. C. B.,	"E. Jordan, Esq.,
"Commodore Douglass, R. N.,	"P. Lawrence, Esq.,
"Hon. S. J. Dallas,	"Hon. T. M'Cormack,
"W. Hyslop, Esq.,	"Hon. E. Panton, Speaker,
"J. Taylor, Esq.,	"A. Barclay, Esq.,
"Hon. H. Mitchell,	"H. Leslie, Esq.,
	"G. Wright, Esq.

"On the designs and specification of Alexander Gordon, Civil Engineer, London."

And on the side supporters:—

"Capt. St. John, R. A., Island Engineer.	"C. Robinson, Engineer, London, *fecit.*"

The whole of the castings were executed by Mr. Robinson at his manufactory, (late Bramah and Robinson) at Pimlico, and put together in the yard of the manufactory prior to their removal for its intended destination,

The work will be re-erected in Jamaica by means of a derrick and crab from the inside, without the aid of any external scaffolding.

ARCH. R. RENTON.

September 22, 1841.

[We understand that the whole expense of the light-house, including the passage over the Atlantic, and the erecting it on the promontory in Jamaica, will not exceed £7,000, and that the entire weight of iron of the whole fabric is about 100 tons. The masonry is being prepared in this country, as it will be more economical to send it from England than it will be to get the stone and work it in Jamaica. Three mechanics are also to be sent out with the work to put it together on its destined spot.—EDITOR.]

Civil Engineer and Architect's Journal.

STIRLING'S AIR ENGINE.

Messrs. Stirling have constructed an air-engine, now working at the Dundee foundry, which fully realizes the expectations of the inventors; its superiority over the steam engine consists in an immense saving of fuel, and in its capability of being contained in a very small space For the purpose of navigation these properties are invaluable. We subjoin a description of the air-engine, furnished us by a friend well acquainted with mechanics.

The air-engine now working at the Dundee foundry, for which a patent was lately taken out, is the joint invention of the Reverend Dr. Stirling, of Galston, and of his brother, Mr. Stirling, engineer, Dundee.

The principle of the invention consists in alternately heating and cooling two bodies of air confined in two separate vessels, which are arranged so that, by the stroke of two plungers worked by the engine, while the whole of the air contained in one of the vessels is at the lower end immediately over the furnace, and is consequently quite hot; the whole of the air contained in the other vessel is at that time disposed at the upper end, which is cut off from any communication with the furnace, and is therefore comparatively cold.

The expansion caused by the heat renders the air in the one vessel much more elastic than that in the other; and the two ends of the working cylinder, which is fitted with a piston similar to that of a steam-engine, being respectively connected with the two air-vessels; a preponderating pressure is produced on one side of the piston, and it is thereby pushed to the opposite end of the cylinder. By the alternate action of the plungers in the two air-vessels, this end of the cylinder then comes in its turn to be subjected to the pressure, and the piston is thereby pushed back again to its former position, and so it continues a reciprocating motion, and is applied to turn a crank in the same way that a steam engine does.

It has been satisfactorily shown that this engine may be worked with very great economy of fuel as compared with a steam engine; and the principal means of producing the saving is this: that, of the heat which is communicated to the air from the furnaces, only a very small portion is entirely thrown away when the air comes again to be cooled; for, by making the air, in its way from the hot to the cold end of the air-vessel, to pass through a chamber divided into a number of small apertures or passages, the great extent of surface with which it is thereby brought in contact, extracts in the first place, but only temporarily, the greater part of the heat from the air; and afterwards restores it to the air on its passage back again from the cold to the hot end of the vessel. The process of cooling is finally completed by making the air to pass through between a number of tubes in which there is a current of cold water, and thus far the heat cannot be made available again, but the portion which is abstracted in this way is very small.

As a sufficient expansive power could not be attained from using air of the common density of the atmosphere, without either making the diameter of the cylinder, and all the other parts of the engine inordinately large, or subjecting the air to greater alterations of heat and cold than would be convenient, the air is used pretty highly compressed, and a much greater power is thereby obtained upon a given area of the piston.

It is necessary, therefore, to employ a small air-pump to keep up the air to the requisite density; but very little power is expended on this; for, as the same body of air is used over and over again, all that is required of the air-pump, after the engine has been once charged, is to supply any loss that may arise from leakage; and this is found to be very trifling.

The machine has been working occasionally for about six months, and it has been proved, to the satisfaction of the inventors, to be capable of perfoming advantageously the amount of work which they had reckoned on, from their calculations, and from former experiments made on a working model of about two horses power. It has now, for upwards of a month, been doing work in driving all the machinery employed at the extensive engineering works of the Dundee foundry, which a steam engine of approved construction had hitherto been employed to do; and it has been ascertained that the expenditure of fuel is, *ceteris paribus*, only about one-fifth part of what was required for the steam engine; but, as considerable improvements are contemplated in some of the details, it is confidently expected that a much greater saving of fuel eventually will be effected.

The whole machine, including its furnaces and heating apparatus, stands in about the same space that a steam engine of equal power would occupy without its furnaces and boiler; and, taking into account this saving of space, along with the vast saving of fuel, the invention must necessarily be of immense imporance for all ordinary purposes requiring motive power; and, as an instance, it would reduce the expenses of the power employed in driving machinery in Dundee alone by at least £25,000 or £30,000 a year;

but viewed in reference to the purposes of navigation, the application of this invention must lead to results still more extraordinary, and will render a voyage to India round the Cape by machinery, a matter of perfectly easy accomplishment.—*Dundee Advertiser.*

THE ZINCING PROCESS.

We derive from the *Revue Generale de l'Architerture* the materials for the following notes on the process of zincing iron, is described by the Baron Menu de Mesnil, in the report of the committee of inquiry to the Minister of Marine in France. On the importance of preserving iron from oxidation it is unnecessary to make any remark, we may just observe that the only effective modes hitherto used have been tinning and glazing. In 1742, M. Maloin presented to the Royal Academy of Sciences a memoir on the analogy which he had observed between iron and tin, and points out a mode of zincing iron similar to the modern one. Whether the price of zinc was then too high or other difficulties stood in the way, it was not until 1836, that the process of zinking was made effective by M. Sorel, who took out a patent for it under the name of galvanization of iron. On the 28th September, 1838, a committee was named by the Minister of Marine to make experiments in the dockyard at Brest on zincing iron, by them a first report was made recommending experiments to be made on a larger scale, which latter commenced on the 14th of May, 1840, and it was on the 30th of April, of the past year, that they made their report.

The process consists simply in dipping an iron article, previously cleaned with acid, for three or four minutes into zinc infusion, then taking it out progressively, shaking it in the air to get rid of the excess of zinc, and at last plunging it suddenly in cold water; after which it only requires to be rubbed over with fine sand and dried. What is called galvanization is therefore nothing more than a process similar to tinning; but while iron is rendered more oxidable by contact with tin, and oxidizes rapidly, if by any mistake in the preparation the iron is left uncovered in any point; in zincing, on the contrary, a true alloy of zinc is formed on the surface of the iron, and the parts accidentally left unzinced alone rust, and the evil is soon stopped. This latter fact is enough to prove that the iron is not protected by any galvanic effect, as is the opinion generally received. Thus in the operations preparatory to zincing, such as cleaning by acid, etc., great care is taken to free the surface of the iron by scraping from it all matters which would resist the action of the acid, and prevent zinc from attaching to the iron all over.

The cleaning with acid is an operation which requires much care, for while it is indispensable that the iron subjected to the acid should be wholly free from rust, care must also be had that the iron be not too strongly acted upon by the acid, but be taken out at the proper moment. Very weak acids only are used for the cleaning as a mixture of nine parts of sulphuric acid with one hundred of water. In France, the refuse acid used in purifying vegetable oils is also

employed; after a certain time the acid can no longer be used, as it is almost wholly turned into sulphate of iron, a salt which may be readily extracted, and which would bring more than the worth of the acid used. The time during which the iron is kept in the acid varies, according to the degree of rust, from twelve to twenty-four hours.

The pieces, after coming out of the acid bath, are cleaned and passed rapidly into hydrochloric acid of 15°, and then put in a stove to be quite dried. It is in this state of absolute dryness, that they may be plunged into the zinc infusion. At the time of immersion, the object is powdered over with sal-ammoniac, a great part of which volatilizes, and then decomposes, and the remainder, the acting portion, cleanses the object a third time, and makes the zincing certain and perfect. The use of this salt, on account of its value and the large quantity used, forms a great part of the cost of zincing. The zinc bath soon becomes covered with a black fluid matter, without adherence to the surface of the bath, on which it forms a continuous layer. The workmen consider it as advantageous to the zincing, and therefore take it out of the bath after the day's work, and put it in again the next morning, when they go back to work. During the night, the zinc it kept in fusion, and the surface exposed to the air, is tarnished and oxidized, and it may be, therefore, allowed that the black matter acts so as to dissolve the oxide formed, and thus to restore the surface of the zinc to the purity requisite for zincing properly. An analysis of this black matter, made at Brest, by M. Langonne, first class naval apothecary and member of the committee, shows it to be composed of a great quantity of chlorure of zinc, a small portion of chlorure of iron, and an insoluble compound of ammoniac and zinc. As we know, therefore, that chlorure of zinc and ammoniac are good detersives, it is not suprising that the black matter, having an analogous composition, should be equally efficacious. The time that objects remain in the zinc bath depends on the dimension, if they are thin, they must be only rapidly passed through, if massive, they must be left some minutes. In general, it is enough to take the objects out as soon as they leave off giving out smoke or rather steam.

The immersion of the zinced object, still quite hot, in cold water, is for the purpose of preventing the formation of oxide of zinc, which tarnishes the surface, but this operation gives the iron a kind of tempering, which added to the effect of a layer of alloy covering the surface, renders it more brittle. Sheet iron in particular, on account of its thinness, is subject to this inconvenience, and can no longer be bent with ease. An improvement has, however, been recently made, which avoids the dipping, the slight layer of oxide of zinc which is formed on the surface, and which does not stick, is easily got rid off by rubbing, after the object has been cooled in sawdust and sand.

When objects have just been zinced, they have a metallic lustre, which they will keep for a long time, when free from damp, but when left in the air they by little and little tarnish, become covered with a whitish efflorescence, which increases, acquires consistency,

sticks to the metal, and soon forms a continuous and solid layer, which preserves the surface from ulterior alteration. This transformation is slow in taking effect, and appears to be complete only after fifteen or eighteen months's exposure to the air. Even the weakest acids and the alkalis attack and desolve the zinc with the greatest facility and bare the iron. Heated red for several minutes the layer of zinc in access soon peels off, but the iron is not yet bared, as the alloy of zinc and iron, more adherent, harder and less fusible, long repel the action of heat.

The thickness of the zinc layer is very small; on common balls it was only sixteen-hundredths of a millimeter, on sheet iron it was from seven to twelve-thousandths of a millimeter, nine-thousandths is the mean. The thickness has little effect on the windage of cannon balls, but the committee suggest that zincing might be employed to increase the diameter of deficient balls. The committee farther suggested that experiments should be made to zinc old iron objects in order to preserve them. The thickness of the layer of zinc, although so very small, is amply sufficient, when we consider that an alloy is formed with the iron, which extends its protective influence deeper into the metal.

The influence of the air or water is very little on the zinced iron, if entirely exposed, but if subjected to the action of water and air alternately, they are more affected. Zinced apparatus produces no injurious effect upon drinkable water.

As to the various articles on which they experimented, the committee report that the zincing appears very effective for roofs and cisterns. Zinced nails and bolts are recommended for shipping, but the committee are not yet prepared to recommend them to supersede copper. These nails are recommended for the decks of ships, as the ordinary nails soon produce a black spot on the surface of the wood, which penetrates and affects the fibres, gallate of iron being produced. Zinced nails are strongly urged as substitutes for iron in securing slates on roofs, as the iron nails soon rust, particularly near the sea, and in high winds are the chief cause of the slates falling. The zinced gutters the committee consider will supersede tin. For the flues of stoves, the zinced iron is recommended, and zinced wire also meets with their approbation. They had not made sufficient experiments as to chains, but they reported that those which they had tried, when put to the hydraulic test, supported it well. For locks and bolts in lighthouses and sea buildings, zincing is exclusively advocated. An advantage which zinc possesses for ear-rings for sails is, that it does not rust the sails, which is apt to rot them.

The committee conclude by making several recommendations. They reported that zincing of wrought and cast iron can easily be practised in all ordinary circumstances of the use of that metal,—that zincing shows every symptom of durability, and that it is of the greatest advantage to the navy. They consequently recommend a contract to be made with the patentee for the use of zinc in the arsenals of France, being convinced of its efficacy.—*Civil Engineer and Architect's Journal.*

RAILWAYS AND STEAM POWER 3,600 YEARS AGO.—THE LOST ARTS OF THE ANCIENT EGYPTIANS.—If the Thebans 1,800 years before Christ, knew less in some departments of useful knowledge than ourselves, they also in others knew more. They possessed the art of tempering copper tools so as to cut the hardest granite with the most minute and brilliant precision. This art we have lost. Again, what mechanical means had they to raise and fix the enormous imposts on the lintels of their temples at Karnac? Architects now confess that they could not raise them by the usual mechanical powers. Those means must, therefore, be put to the account of the "lost arts." That they were familiar with the principle of Artesian wells has been lately proved by engineering investigations carried on while boring for water in the Great Oasis. That they were acquainted with the principle of the railroad is obvious, that is to say, they had artificial causeways, levelled, direct and grooved, (the grooves being anointed with oil) for the conveyance from great distances of enormous blocks of stone, entire stone temples and colossal statues of half the height of the monument. Remnants of iron, it is said, have lately been found in these grooves. Finally, M. Arago has argued, that they not only possessed a knowledge of steam power which they employed in the cavern mysteries of their pagan freemasonry, (the oldest in the world, of which the pyramids were the lodges,) but that the modern steam engine is derived, through Solomon de Caus, the predecessor of Worcester, from the invention of Hero, the Egyptian engineer.—*Westminster Review.*

PLEASURE OF STEAM TRAVELLING.—Our ancient friend, John Gilpin, in his trip to Edmonton, seems almost revived in the person of the reverend gentlemen described in the following narrative, from a Chelmsford journal:—Last week the Rev. C. B. Marriott, of Thundersley, having decided to proceed to the rustic quietude of Harlow, determined on entrusting himself on the Northern and Easten rail; accordingly he possessed himself of a snug first class seat, and was soon spinning along before the gale to his destination. "Harlow Station" at last stared him in the face, as plainly as paint and board could stare; but alas! the carriage door had become fixed by the rain; all his exertions could not get it down to enable him to serve the officers with notice of his intention to quit. All his calling out, and hammering the glass, as heavily as glass may be safely hammered, brought no one to his prison door; and as it was in vain for him to attempt to put a bit in the mouth of a steed which is fed with coke and driven with a kitchen poker, he soon found himself whirling along to the next station at Sawbridgeworth. Here he succeeded in achieving his liberty; and was consoled by the information that, on the *usual* terms, he could be conveyed back to Harlow. In due time the reverend traveller resigned himself to his fate and to the uptrain, but scarcely was he under weigh, when his fellow passengers informed him that *that* train did not stop at Harlow. This was too true; onwards went the monster with puff and snort, regardless of his wishes—all he saw of the desired haven of his hopes being the glimpse which steam, at thirty miles an hour,

afforded him. Of course it was useless lingering at the next station, so onwards he flew to town, where, on a proper representation of the case to the directors, the hotel expenses of the night were paid by them; and the next morning he was again skimming the earth towards Harlow. Again the painted board announced to him his journey's end; again, too, the carriage door became obstinate in its slides, and it was not till the train was almost again in motion that the reverend gentleman was enabled to set foot upon the desired spot; even then it was not effected without some risk, as, in his haste to avoid a second trip to Sawbridgeworth, he did not perceive another leviathan, who a few yards off was hissing and boiling up the rail upon which he alighted.—*Chelmsford* (*English*) *Chronicle.*

Great Performance—New Locomotive.—A new locomotive called the "Lycoming," from the manufactory of D. H. Dotterer and Co's. works, weighing with water and fuel 10 tons, was placed on the Reading railroad, about a week ago. As a specimen of the abilities of the engine, we mention two of her trips. On the 2d inst., she brought from Pottsville to Reading 66 cars, 50 of which were loaded each with 3½ tons of coal—starting the train on a dead level and curve without slipping a wheel. On the following day, the engine drew from Reading to Philadelphia a train 890 feet long, consisting of 72 coal cars, carrying 239 tons freight—the cars weighing 134 tons—the gross weight of train being 373 tons of 2,240 lbs., not including engine and tender. The engine started this tremendous train at the different watering stations without slipping a wheel. The day was wet, and the train had to contend with a strong head wind, the effect of which (especially as some of the cars were "house cars") is well known. It is believed by competent judges, that under favorable circumstances, this engine would take over the same road a train of 90 cars, weighing with freight, 450 tons! This is the 9th engine built by D. H. Dotterer and Co., and is upon an improved plan.—*Reading* (*Penn.*) *Journal.*

Vegetable Ivory.—Were yesterday presented with a beautiful turned cane, or umbrella head, which has all the appearance, as regards whiteness, hardness and close texture, of the finest ivory. We we were much astonished when informed that it was a vegetable production, and grew upon a tree in one of the southern islands in the South Pacific ocean, procured by the French discovery ships. It is evidently of the cocoa-nut family, and we are informed by the gentleman to whom we are indebted for it, that some of the nuts from one of which, this head is made, are of a size sufficiently large to make a billiard ball. It is certainly very curious and important discovery, and will, should it be proved as durable as ivory, decrease the demand for the tooth of the elephant.—*Phil. paper.*

Atchafalaya Raft.—The Opelousas Gazette of the 29th January says: "Captain Mayo, the superintendant of the boat and hands at work in clearing out the Atchafalaya raft, informed us a few days since that the work was being efficiently executed, and the boat

would not leave the raft until the work of destruction was accomplished. A mile and a quarter remains yet to be completed. Such is the effect of what is doing, that, we are told, the raft begins to give. This is a favorable state of things; and we may indulge in the hope that, ere long, our navigation will be at all time practicable.

THE NEW BRIDGE.—The viewers appointed by the Court of Quarter Sessions, on the part of the county of Philadelphia, to inspect the new bridge at Fairmount, and report upon the merits of its construction, performed that duty yesterday. The result was in the highest degree satisfactory to the committee, and creditable to the builder, Mr. Ellet. Among other modes, to test the strength of the bridge, forty carts containing each two tons of stone, were at the same time placed upon it.

FROM LATE FRENCH PAPERS.

The annual increase in the number of travellers on the Rhine is a striking proof of the effect of the introduction of more rapid means of communication. In 1827 the number of passengers on the Rhine, by the Cologne steamers, was between 18,000 and 19,000, and this was thought considerable; but in 1839 the number had increased to 487,000; in 1840 to 636,000; and in 1841 it has been estimated at 750,000. In the course of the present year there will be 35 steamers on the Rhine, of which 16 belong to the Cologne company, 7 to the company of the Netherlands, 6 to the Dusseldorf company, 2 to the Rhine and Yssel company, 2 to the company, of the *Aigle*, and 2 to the Basle company.

It appears from a statement in the Brussels papers that the *material* of the different Belgian railways at this moment consists of 126 locomotives, 117 tenders, 95 diligences, 179 chars-a-banc, 235 wagons for passengers, 854 carriages for goods, and 202 wagons for material of the roads, etc.

A project has been started at Munich by M. Wiebeking, who is well known in Germany by his connexion with railroads, for convoking in the Bavarian capital a sort of Congress, or general meeting of European engineers, to communicate discoveries and discuss theories relative to railroads. If the project is carried into effect, the first meeting will be held this year.

The united councils of agriculture, manufactures, and commerce, met yesterday for the discussion of the iron question. Amongst other propositions which were brought forward, was one for permitting Belgian iron to enter France, in competition with French iron, for the construction of the great lines of railway which are projected.

The total system of railroads now propsed to be constructed in France is to extend to 400 leagues, which will require 200,000 tons of wrought iron.